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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/003,358

11/14/2001

Fang-Cheng Chang

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02/23/2005

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EXAMINER

LIN, SUN J

ART UNIT

PAPER NUMBER

2825

DATE MAILED: 02/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/003,358

Applicant(s)

CHANG, FANG-CHENG

Examiner

Sun J. Lin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Amendment & Remarks filed on 11/12/2004.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11/14/2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

1. This Office Action is in response to applicant's Amendment and Remarks filed on 11/12/2004 regarding application 10/003,358 filed on 11/14/2001. Claims 1 – 27 remain pending in the application.

Claim Rejections - 35 USC § 103(a)

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

- (1). Determining the scope and contents of the prior art.
- (2). Ascertaining the differences between the prior art and the claims at issue.
- (3). Resolving the level of ordinary skill in the pertinent art.
- (4). Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,272,236 B1 to Pierrat et al. in view of U.S. Patent No. 6,057,063 to Liebmann et al.

4. As to Claim 1, Pierrat et al. show and teach the following subject matter:

- Image simulation procedures capable of detecting anticipate defects on a mask – [col. 3, line 14 – 26]; capturing (i.e., generating) inspection image of a portion (e.g., critical feature) of the mask and creating a simulation of resist to be formed (on a wafer) according to the inspection image – [col. 3, line 49 – 51]; Notice that the portion of mask containing a critical feature, which requires special attention, is an area of interest (AOI); Therefore, an AOI (area of mask containing a critical feature portion) is identified first, and then

an inspection image of the critical feature portion in the AOI is generated for use in the simulation;

- Mask pattern is manufactured from original (design) pattern data – [col. 3, line 45 – 46];
- Mask inspection machine can be applied to any particular type of masks, which include photomask and phase shifting mask – [col. 6, line 19 – 27]; Notice that (1) a photomask is designed for a desired design pattern, including a critical feature portion in an AOI, it is manufactured utilizing original (design) pattern data – [Fig. 3] (2) a phase shift mask associated with the AOI is constructed based on design geometry information regarding an area outside the AOI without use of inspection images of that area.

Pierrat et al. do not disclose information about construction of phase shifting mask and its relationship with a (critical) feature. But Liebmann et al. show and teach the following subject matter:

- A process for creating and verifying a design of phase-shifted mask – [title; abstract];
- Phase-shifted masks are deployed to (critical) features in a chip design that require phase shifting – [abstract; col. 3, line 59 – 62];
- Phase-shifted mask contains colored phase regions, which are created on opposite sides of features – [abstract; Fig. 1 – Fig. 4]; Proper phase termination (e.g., 180° out of phase) of the phase regions is ensured based upon space constraints of a phase-shifted mask technique utilized – [abstract].

In addition, Liebmann et al. also teach that phase shifted mask (PSM) lithography is applied to improve the lithographic process latitude in order to replicate small image (i.e., critical feature) in a chip design – [col. 2, line 34 – 56].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of Liebmann et al. in utilizing phase shifted mask to improve the lithographic process latitude in order to replicate small image (i.e., critical feature) in the AOI.

Notice that Liebmann et al. also show and teach the following subject matter:

- a photomask design showing (critical) feature edges – [Fig. 1];
- phase regions of phase shifted masks, which are deployed around the photomask of each (critical) feature edges – [Fig. 2];

Therefore, in order to appropriately deploy the appropriate phase regions of a phase shifting mask around an AOI having a critical feature, the design geometry information regarding an area outside the AOI should be provided and modified to accommodate the phase regions.

Combining the teachings of Liebmann et al. and Pierrat et al., the following subject matter is disclosed utilizing Fig. 1 of Pierrat et al.:

- Simulation of a critical feature in the AOI is performed in Step 180 based on the inspection image of the AOI and the phase regions of a phase shifting mask deployed around the AOI according to design geometry information regarding an area outside of the AOI– [Fig. 1]; Notice that (1) the image simulation of desired design pattern of the critical feature (AOI) under study is performed in Step 185 (2) inspection images of the phase shifting mask are not used in the simulation.

For reference purposes, the explanations given above in response to Claim 1 are called **[Response A]** hereinafter.

5. As to Claim 18, reasons are included in **[Response A]** given above.

6. As to Claim 27, reasons are included in **[Response A]** given above. Notice that based on the explanations included in **[Response A]**, a computer program product can be generated to perform the subject matter as recited in Claim 27.

7. As to Claim 25, reasons are included in **[Response A]** given above. Notice that accuracy of the critical feature is based on the following factors:

- a mask inspection image, which has a defined area (i.e., area defined the critical feature); and

- design geometry information regarding an area outside the defined area, where appropriate phase regions of phase shifting mask are deployed around the defined area.

For reference purposes, the explanations given above in response to Claim 25 are called **[Response B]** hereinafter.

8. As to Claims 2 and 19, modifying data include colors and layout data of phase regions for use in the phase shifting mask around the critical feature in the AOI in order to achieve appropriate phase shifting. Notice that the colors of phase regions are set to control the degree of phase shifting (e.g., 180° out of phase) between the phase regions.

9. As to Claims 3 and 20, modifying data includes generating phase regions of phase shifting mask outside and around the AOI and combining the inspecting image of critical feature and the phase regions of phase shifting mask. Notice that an image generated by the phase regions of phase shifting mask is a phase shifting image, which is a virtual image.

For reference purposes, the explanations given above in response to Claims 3 and 20 are called **[Response C]** hereinafter.

10. As to Claim 4, as explained in **[Response A]** given above, the simulation 180 is performed on the combined images 160.2, which is a combination of the inspecting image and the image of phase regions of phase shifting mask received from Step130 – [Fig. 1].

For reference purposes, the explanations given above in response to Claim 4 are called **[Response D]** hereinafter.

11. As to Claims 5, 6 and 21, reasons are included in **[Response C]** and **[Response D]** given above.

12. As to Claims 7 and 22, Pierrat et al. show and teach digitized image of entire mask, including feature in AOI and (design geometry information for use in construction

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of associated phase shifting mask – [Fig. 1; Fig. 3; col. 5, line 45 – 50]. Notice that a digitized image is a bit map image, which is made of bits “1” and bit “0”.

For reference purposes, the explanations given above in response to Claims 7 and 22 are called **[Response E]** hereinafter.

13. As to Claims 8 and 23, the design geometry information is utilized in formation of phase shifting mask for a (critical) feature in an AOI. Therefore, the design geometry information includes extending geometries of the (critical) feature in the AOI – [Liebmann et al.; Fig. 1 – Fig. 5].

14. As to Claims 9 and 10, as explained in **[Response A]** given above, providing design geometry information includes accessing information regarding another mask, which is a phase shifting mask – [Liebmann et al.; Fig. 1 – Fig. 5].

For reference purposes, the explanations given above in response to Claims 9 and 10 are called **[Response F]** hereinafter.

15. As to Claim 24, reasons are included in **[Response F]** given above. Notice that, in design of an appropriate phase shifting mask, database information regarding phase shifting (i.e., colors) and sizes for use in design of phase regions of the phase shifting mask needs to be accessed.

For reference purposes, the explanations given above in response to Claims 9 and 24 are called **[Response G]** hereinafter.

16. As to Claim 26, in addition to reasons included in **[Response A]**, **[Response B]**, **[Response C]**, and **[Response D]** given above, Liebmann et al. and Pierrat et al. show and teach the following subject matter:

- (Photomask) image simulation obtained in Step185 is based on desired pattern database, it provides a first accuracy – [Pierrat et al. – Fig. 1];
- Mask inspection image with phase shifting mask generated in Step180 provides an improved accuracy – [Pierrat et al. – Fig. 1; Liebmann et al., col. 2, line 34 – 40];

- Improved accuracy of image simulation 180 is compared with first accuracy in image simulation 185 to detect defect in 140 – [Pierrat et al. – Fig. 1].

17. As to Claim 11, in addition to reasons included in [Response A] and [Response G] given above, Pierrat et al. teach that the inspection image is a digitized image generated from an inspection tool (e.g., scanning electron microscope SEM) – [col. 5, line 8 – 18; col. 5, line 45 - 50]. Notice that the Inspection image is first information relating to a first area (i.e., AOI) – [Response A]. Second information is obtained from design geometry information (i.e., design file for phase shifting mask). The Second information is related to area of phase region (i.e., second area) of phase shifting mask outside the first area (AOI) – [Response G]. Notice that the first information (inspection image of AOI) and the second information (phase shifting mask) provide enhanced simulation accuracy of the first area (AOI).

18. As to Claim 12, reasons are included in [Response E] given above.

19. As to Claims 13 and 14, Liebmann et al. show in Fig. 1 and Fig. 2 and teach that the second area (phase region) for use in designing a phase shifting mask is defined by a predetermined spacing (i.e., distance) or a plurality of spacings (i.e., distances) from a perimeter of the first area (i.e., feature edge under study) dependent upon structure and size of the critical feature edge in the first area.

20. As to Claim 15, the first area is a feature in any AOI. The first area (feature) can be defined by an engineer (i.e., user) by choosing an AOI when operating the simulation engine.

21. As to Claim 16, Liebmann et al. teach the following subject matter:

- Phase shifted mask design system for manufacturing VLSI circuit device – [abstract];
- Mask process for creating and verifying a design of phase shifted mask utilizing at least one phase shift region employing a computer-aided design system – [abstract]; Notice that the phase shifted mask design system is a computer-aided

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design system; The second area (phase region) can be defined by the phase shifted mask design system

- Critical features in a design of the phase shifted mask (for a VLSI circuit device) that required phase shifting are located – [abstract]; Notice that the first area (i.e., critical feature) is located (i.e., defined) by the phase shifted mask design system.

22. As to Claim 17, as explained in [Response A] given above, the first area relates to photomask (i.e., first mask) of a desired pattern of a critical feature and the second area (phase regions) relates to phase shifting mask (i.e., second mask) associated with the photomask (first mask).

Response to Amendment and Remarks

23. Applicant's amendment and remarks filed on 11/12/2004 have been reviewed. Applicant's arguments have been fully considered but they are not persuasive. Detailed responses to applicant's argument are included in the office action given above.

Conclusion

24. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sun J. Lin whose telephone number is (571) 272-1899. The examiner can normally be reached on Monday-Friday (9:00AM-6:00PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 305-3413 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

Sun James Lin
Patent Examiner
Art Unit 2825
February 9, 2005



VUTHE SIEK
PRIMARY EXAMINER